Supporting sexuality and improving sexual function in transgender persons

Mats Holmberg[1,2], Stefan Arver[1,3] and Cecilia Dhejne[1,3]*

Abstract | Sexuality is important for most cisgender as well as transgender persons and is an essential aspect of quality of life. For both the patient and their clinicians, managing gender dysphoria includes establishing a comfortable relationship with sexual health issues, which can evolve throughout the course of gender-affirming treatment. Gender-affirming endocrine treatment of transgender men and women has considerable effects on sex drive and sexual function. Gender-affirming surgery (GAS) can improve body satisfaction and ease gender dysphoria, but surgery itself can be associated with sexual sequelae associated with physical constraints of the new genitals or postsurgical pain, psychological difficulties with accepting the new body, or social aspects of having changed gender. In general, a positive body image is associated with better sexual function and satisfaction, but satisfaction with sexual function after GAS can be present despite dissatisfaction with the surgery and vice versa. Factors involved in the integrated experience of gender-affirming treatment and the way in which sexuality is perceived are complex, and supporting sexuality and improving sexual function in transgender patients is, correspondingly, multifaceted. As the transgender patient moves through their life before, during, and after gender-affirming treatment, sexuality and sexual function should be considered and maximized at all stages in order to improve quality of life.

Gender identity refers to an innate and deeply felt identification as a female, male, or some other nonbinary gender, and is one of many aspects of sex or gender[1,2] (BOX 1). For many years, gender identity was viewed as binary: an individual could be either female or male. However, more recently, gender identity has become viewed as a spectrum, whereby female and male are two of many gender identities that can also include nonbinary, gender fluid, transgender, gender queer, transgender masculine, and transgender feminine[3,4]. The gender identity of a person can be congruent or incongruent with the sex assigned at birth. Gender dysphoria refers to discomfort or distress sometimes caused by gender incongruence[5]. Transition is the process by which someone starts to present themselves permanently accordingly to their gender identity[6]. Some individuals ease their dysphoria with a social transition (change of name, gender expression, and/or gender role), whereas others might seek gender-affirming treatment in order to alter the body so that it is in line with their gender identity, alleviating gender dysphoric symptoms[5–8]. The latter is sometimes called medical transition.

The global prevalence of diagnosed gender dysphoria has been estimated in two meta-analyses (including studies up to 2014) at 4.6–6.8 per 100,000 (REFS[9,10]). Since then, a study from the Netherlands estimated the prevalence of individuals who have undergone gender-affirming treatment before 2015 to be 27.7 per 100,000 people (95% CI 26.8–28.6)[11]. In a report that included data up to 2015, self-reported gender dysphoria or self-identified transgender identity had a global prevalence of 871 per 100,000 (95% CI 519–1,224) or 355 per 100,000 (95% CI 144–566) with removal of an outlier[10]. Since then, 500 of 100,000 people (0.5%, 95% CI 0.4–0.7%) from a representative sample of the population aged ≥22 years in Stockholm county, Sweden, answered 'yes' when asked if they would like to change their body with hormones or surgery to be more like a person of a different sex[12].

The incidence and prevalence of gender dysphoria is increasing[9,11,13]. In Sweden the incidence of applications for change of legal gender increased almost threefold from 0.20 per 100,000 per year in 1972–1980 to 0.57 per 100,000 per year in 2001–2010. In the Netherlands a 20-fold increase of assessment from 34 in 1980 to 686 in 2015 was reported[11].The increase might reflect an increase in people openly discussing gender as society has become more inclusive, but a true increase in prevalence cannot be ruled out[9,10,13]. Conceptualization of gender incongruence and gender dysphoria changes continuously, as has the language describing these phenomena[14] (BOX 2).

[1]*ANOVA, Karolinska University Hospital, Norra Stationsgatan 69, Stockholm, Sweden.*

[2]*Institute of Medicine, Sahlgrenska Academy, University of Gothenburg, Göteborg, Sweden.*

[3]*Department of Medicine, Huddinge, Karolinska Institutet, Stockholm, Sweden.*

**e-mail: mats@xnet.se*

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Key points

- Evaluation of sexual dysfunction in transgender persons is multidimensional.
- Hormonal treatment is likely to increase sexual desire in transgender men and decrease desire in transgender women.
- A reduction in sexual drive is not necessarily a concern, but can, in fact, be appreciated or even desirable for some patients.
- Before initiating hormonal or surgical treatment, wishes and hopes about future sexual function should be explored.
- Sexual problems in transgender persons can be trans specific or not. General principles in sexual medicine apply to both cisgender and transgender persons.

The transgender population is heterogeneous[5,15] and many efforts have, therefore, been made to stratify the population into subgroups, in order to predict treatment outcomes and to attempt to understand the aetiology of gender incongruence[16,17]. Besides subgrouping assigned females or males at birth, the most common subdivisions have been based on early-onset and late-onset gender dysphoric symptoms. No strict definitions exist, but early onset is often defined as gender incongruence or gender dysphoric symptoms during childhood or before puberty, or used to describe a patient who fulfils the diagnostic criteria for gender dysphoria during childhood; late onset is often defined as during or after puberty[18]. Subdivisions have also been made based on the person's sexual orientation[18–23]. However, information regarding age of onset or sexual orientation in clinical studies is likely to be biased, as many treatment facilities have restricted access to care for certain subgroups. Thus, in order to be offered treatment, patients might have adjusted or misreported their medical history[15,16,18,24]. In one study, 12% of transgender women claimed that they had concealed their sexual orientation at assessment[25]. Likewise, in a Finnish study, 44% of patients reported that they delivered a falsified story at assessment in order to access gender-affirming treatment[24]. Today, fewer obstacles restrict access to gender-affirming treatment, so information collected should become more reliable[19].

Transgender health care is multidisciplinary, as described in the Standards of Care version 7 (SOC 7) from the World Professional Association for Transgender Health (WPATH)[5]. Not all individuals with gender dysphoria need, or can access, the full spectrum of different gender-affirming treatments, and many countries still do not allow legal sex change including assigned official documents stating a new legal sex or gender marker, for example Brazil, Chile, Cyprus, Macedonia, Tanzania, Thailand, and Uganda. In many countries, a change of legal sex or gender marker is only possible if the applicant has fulfilled certain requirements, such as having a medical diagnosis, living according to the preferred gender role, having undergone any gender-affirming treatment, having undergone gender-affirming genital surgery, or being sterile. Change of legal sex or gender marker based on self-determination via an easy administrative procedure is only possible in a few countries (Argentina, Colombia, Denmark, Ireland, Malta, and Norway)[26]. This Review is based solely on literature published in countries where gender dysphoria is recognized as a medical condition and where access to care is, at least for some patients, affordable. The global situation is completely different: in many countries transgender individuals are not recognized, in some countries they are regarded as criminals, and in some jurisdictions being transgender is even considered a legitimate reason for the death penalty[27,28]. Even in more tolerant parts of the world, transgender persons face social marginalization, stigma, discrimination, violence, and difficulties in accessing health care[2,14,26,29,30]

Sexual health is defined by WHO as being a state of physical, emotional, mental, and social well-being related to sexuality; it is not merely the absence of disease, dysfunction, or infirmity[31]. Sexual dysfunctions arise when impaired sexual function causes distress and are often divided into four categories: lack of desire or interest, arousal dysfunction, orgasm and/or ejaculatory dysfunctions, and pain during sexual activities[32,33]. Sexual desire is often seen as an amalgamation of different components: sexual drive (biological), sexual motivation (cognitive), and responsiveness to sexual stimuli[34]. Sexuality and sexual function are influenced by biological, intrapersonal, and interpersonal factors, as well as socioeconomic, political, cultural, ethical, legal, historical, religious, and spiritual factors[31].

Sexual satisfaction refers to the affective response to the individuals' expectations or evaluation of the balance of negative and positive dimensions of someone's sexuality and is more than simply sexual function[35,36], which is just one of the determinants of sexual satisfaction and sexual health[35]. Cross-sex hormonal therapy (CHT) and gender-affirming surgery (GAS) can affect sexual functions such as desire and/or sexual interest, arousal, and ability to orgasm[37,38]. However, body image, self-esteem, psychological well-being, and sexual anxiety are also important aspects of sexual health and satisfaction[35,39–41]. Gender-affirming treatments ease gender incongruence and gender dysphoria[42], but body image, body self-esteem, and psychological well-being might be affected even after treatment[40,43,44].

In this Review, we will identify clinical factors of importance for the sexual health of transgender persons before, during, and after undergoing different

Box 1 | **Aspects of gender**[291]

Legal gender
The gender defined in legal documents and birth certificate.

Chromosomal sex
Karyotype describing the presence or absence of Y and/or X chromosomes.

Hormonal sex
Female or male sexual hormone pattern.

Anatomical sex
Female or male primary and secondary sex organs.

Gender identity
The perception of being a man, woman, or some other gender.

Gender expression
How the person expresses their gender identity in a social context with more or less well-defined social gender characteristics, for example the way of dressing.

Gender role
Behaviours, attitudes, and personality traits, which in a given society and historical period are typically attributed to, expected from, or preferred by persons of that gender.

Box 2 | **List of definitions**

Androphilic
Sexual orientation towards men or masculinity[81].

Birth-assigned sex
The sex and/or gender that was assigned at birth. This supersedes the terms 'biological sex', 'natal sex', or 'actual sex'. If chromosomal, gonadal, hormonal, or genital sex characteristics are discussed, these terms should be used[14].

Cisgender person (cis person)
A person whose gender identity matches the sex assigned at birth and who, unlike transgender people, does not experience gender incongruence[2].

Gender binary
A view that there are only two genders (girls and/or women and boys and/or men) that are separate and unchanging[3].

Gender-affirming treatment
Medical treatments aiming to alter the bodily characteristics in order to align with the person's gender identity and ease gender dysphoria. Examples of gender-affirming health care include hormone treatments, hair removal, vocal training, and gender-affirming surgery[29].

Gender-affirming surgery
Range of surgeries that create physical characteristics that are in line with gender identity, including vaginoplasty, breast augmentation, cricoid surgery, vocal cord surgery, chest surgery, and phalloplasty. Sometimes referred to as sex reassignment surgery (SRS)[292].

Gender dysphoria
Distress caused by gender incongruence[2,29].

Gender Dysphoria
Refers to the diagnostic term in DSM-5 (REF.[156]). The diagnostic criteria includes male, female, and other gender.

Gender Identity Disorder
Refers to the diagnostic term in DSM-IV and DSM-IV-TR[293,294].

Gender nonconforming
This term refers to people who do not conform to society's expectations for their gender roles or gender expression. Another term used for this is 'gender-variant'[292].

Gender normative
Gender roles and/or gender expression that matches social and cultural expectations.

Gender transition
A person's adoption of characteristics that they feel match their gender identity. Gender transition can involve social, physical, and legal aspects of transition. Social transition includes changing appearance (including styles of dress and hair), name and pronoun. Legal gender recognition includes change of legal gender and arranging new identity documents. Physical transition can facilitate social transition and includes gender-affirming medical interventions such as hormone therapy and gender-affirming surgery[2].

Gynephilic
A sexual orientation towards women or femininity[81].

Legal gender recognition
The process by which a person's legal gender is changed to align with the person's gender identity[29].

Sexual orientation
Describes to whom one is sexually attracted. The sexual orientation of transgender people should be defined by the individual, and is often described based on the lived gender. A transgender woman attracted to other women would be a lesbian, and a transgender man attracted to other men would be a gay man[2,14].

Sex reassignment
Denotes the process to make a social, legal, and physical gender transition[292].

Sex reassignment surgery
See gender-affirming surgery[292].

Transfeminine
This umbrella term describes people who were assigned male at birth, who are transgender, and whose gender expression leans towards the feminine[29].

Transmasculine
This umbrella term describes people who were assigned female at birth, who are transgender, and whose gender expression leans towards the masculine[29].

Transgender person (trans person)
An umbrella term that describes a wide range of people whose gender and/or gender expression differ from their assigned sex and/or the societal and cultural expectations of their assigned sex[2,295].

Transgender man (trans man)
Denotes someone with a male gender identity who was assigned female at birth[2,295].

Transgender woman (trans woman)
Denotes someone with a female gender identity who was assigned male at birth[2,295].

Transsexualism
Refers to the diagnostic term in ICD-10 (REF.[157]). Transsexualism was also the word Harry Benjamin[23] used to describe individuals who felt that they had a gender identity not in line with their body and needed gender-affirming treatment. Both Benjamin and the ICD-10 diagnosis only acknowledge two genders: male and female.

forms of gender-affirming medical or surgical treatment. Considerations for treatment — both of underlying dysphoria and of any pre-existing or resulting sexual dysfunctions — are also discussed.

The biopsychosocial model

Sexuality and sexual response are complex and, as such, many models of sexual response have been suggested. The linear physiological model describes a response cycle in which individuals progress stepwise from desire, to arousal, to orgasm[45,46]. The dual control model or the sexual tipping point model are similar, and both describe how different biopsychosocial inputs influence sexual function. Thus, a sexual dysfunction occurs when inhibitory factors are not balanced by excitatory factor[47,48]. The incentive motivation model conceptualizes sexual response as an integration of central cognitive affective processes and peripheral responses. For example, perception of a genital response and/or feelings of sexual arousal motivate sexual behaviour and feelings of desire, leading to a rewarding orgasm[49,50]. This model also includes classical conditioning: a history of negative sexual experiences or a lack of positive experiences can alter a sexual incentive to a negative value. For example, if a person has developed severe genital dysphoria owing to gender incongruence, this discord could lead to orgasm being associated with negative feelings, hampering desire, arousal, and orgasm[51,52].

In the past, the aetiological background to sexual dysfunctions was thought to be either biological or psychological. This view has now been largely replaced by the biopsychosocial model (FIG. 1). In accordance with the biopsychosocial model, an assessment of sexual dysfunction should include an evaluation of predisposing, precipitating, and maintaining factors of all aspects of the model, including their interactions with one another[53]. This interaction means that problems in one domain — biological, psychological, or social — can negatively affect other domains.

Biological factors

On a physiological level, sexual function requires adequate hormonal stimulation, as well as sufficient cardiovascular, central, and peripheral nervous system function. Any process, including pharmaceutical drugs, affecting these systems or directly affecting the genitals might compromise sexual function: cardiovascular diseases mostly affect blood flow dynamics during the arousal phase[54]; neurological and psychiatric morbidity can compromise the autonomous, peripheral, and central nervous system and, therefore, also affect blood flow, sexual desire, and orgasmic ability[55]. Psychopharmacological drugs quite often have sexual side effects. Selective serotonin reuptake inhibitors (SSRIs) used for the treatment of depression and anxiety disorder can diminish desire and arousal and delay orgasm and/or ejaculation[56] Likewise antipsychotic drugs used for psychotic and bipolar conditions are well known for their adverse effects on desire and arousal. Opioids, which are sometimes necessary for the treatment of severe pain, suppress the gonadal axis in both men and women[57,58] and can suppress both sexual desire, arousal and orgasmic ability[59]. Studies investigating sexual side effects of pharmaceuticals have been performed on presumed cisgender persons; but it is likely that transgender persons do not differ from cisgender persons in this respect. Diseases or surgery involving the genitals, such as stress urinary incontinence, lichen sclerosis, or prostatectomy, can also negatively affect arousal, orgasmic ability, and sexual desire[60–63].

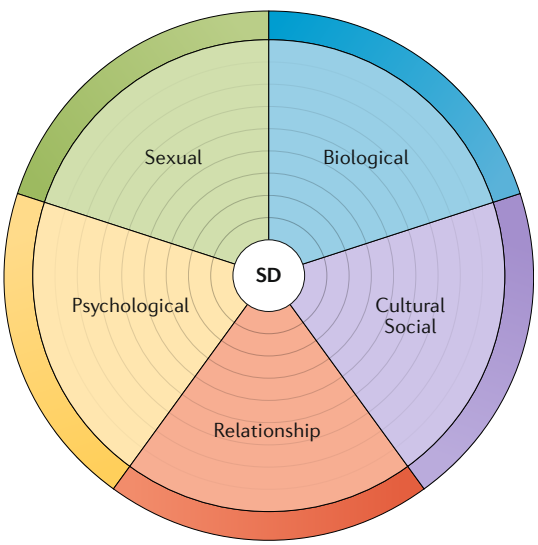

Fig. 1 | **The biopsychosocial model.** Sexual dysfunction (SD) should be understood as a multifactorial problem, with interacting contributing factors. Figure adapted with permission from REF.[53], Elsevier.

Psychological, social and sexual factors

Depression, anxiety, and other mental health problems often suppress desire and arousal, as well as the orgasmic ability[64]. On an intrapersonal psychological level, body satisfaction, body image, self-esteem, self-efficacy, coping strategies, age, and sexual scripts can all have an effect on sexual function and sexuality[53,65].

Sexual scripts — a set of cognitive schemas used to understand and organize sexuality and sexual behaviour[66,67] — are relevant on both intrapersonal and interpersonal levels, as well on as a cultural level, and all levels are interwoven. Cultural sexual scripts are part of the narratives and norms in each society, and provide guidelines regarding whether a sexual behaviour is considered appropriate, for example regarding numbers of partners, ways of having sex, reasons for having sex, and with whom[66,67]. The sexual scripts regarding transgender people are contradictory: where one script might describe transgender people as asexual[68,] another script can objectify and sexualize them[44,69]. Sexual activity does not require a partner, but when a partner is involved, interpersonal factors also become a part of the biopsychosocial model. Interpersonal factors, which arise from either the relationship itself, the partners' sexual function, or the wish for being in a relationship, are likely to affect both sexual function and the person's own sexuality[53]

In order to understand and treat sexual dysfunction, a person's sexual history — including when they began masturbation and/or partner-related sexual activity, positive and negative sexual experiences, view of sexuality, sexual scripts, knowledge about sexual functions, importance of sexuality, and the presence of coexisting sexual dysfunctions — must be assessed. For instance, low desire can cause arousal problems and vice versa[60,70].

Hormonal control of sexuality and function

Endocrine factors are essential for reproduction and sexuality, and sex steroids in particular have specific effects on sexuality and sexual response. The terminology, which uses the terms 'male' and 'female' to describe sex hormones, is — to some extent — misleading, as both testosterone and oestrogen are present in both sexes and can work synergistically (for example, in bone[71] and in the brain[72]), as antagonists (for example, in breast[73] and body hair development[74]), or separately (for example, their effects on sex hormone binding globulin (SHBG) production)[75,76]. Notably, oestrogen levels in postmenopausal women are lower than in men of similar age[77–79]. Most of our knowledge of sex hormones in humans is derived from cisgender persons by studying states of hormone deficiency and restoration of normal sex hormone levels[80]. To what extent this information is transferable to transgender persons is not fully understood.

Disorders of sexual development of various kinds can affect development during the embryonic and fetal period and also during childhood and adult life, and have implications for the role of hormones in developmental

processes and also sexual preferences. For example, studies have shown that gynephilia (sexual orientation towards women or femininity)[81] is considerably more prevalent in women with congenital adrenal hyperplasia (CAH) than in women from a reference population without CAH, indicating a possible prenatal effect of elevated androgen levels on sexual behaviour[82,83]. Androgens are often referred to as 'sex-stimulating hormones', affecting spontaneous interest in sex, ease of arousal, and orgasmic experience[84]. They are also well known to influence sexual desire, with low sexual desire observed in men with hypogonadism restored by testosterone treatment in the same group[85,86]. In cisgender women, the relationship between testosterone levels and sexual desire is less clear[87], although intervention studies in cisgender women with low sexual interest and sexual dysfunction demonstrate a positive effect of testosterone therapy on sexual activity, orgasm, and desire, as well as improvements in general sense of well-being and self esteem[88–90].

One randomized, controlled study has shown that the effect of testosterone treatment on sexual desire in hypogonadal cisgender men is reduced if an aromatase inhibitor (which reduces oestrogen levels) is administered simultaneously, suggesting a synergistic or additive effect of oestrogen on male sexual desire and erectile function[79]. In cisgender women, the role of oestrogen in sexual desire is unclear, with conflicting reports. Sexual desire and frequency of sexual fantasies decrease following oophorectomy[91] and oestrogen treatment can increase desire and orgasm in oophorectomized women[92]. Furthermore, addition of testosterone to hormone replacement therapy (HRT) in oophorectomized and in postmenopausal women further improves sexual function[93,94].

Hyperprolactinaemia is associated with loss of sexual desire in cisgender men even if the testosterone levels are normal[95]. In cisgender women, excess prolactin levels due to lactation or a prolactin-producing tumour cause amenorrhoea and diminished sexual interest. This effect could be considered functional, as it lowers the chance or risk of becoming pregnant too early in women who are caring for a newborn. Furthermore, sexual activity and orgasm release a series of neurotransmitters and hormones, such as oxytocin, that might be involved in the positive experience of having sex[96].

Thus, the role of hormones in controlling and maintaining sexual function and desire illustrates the biopsychosocial model, whereby a biological factor (hormones) controls psychological factors (for example, desire and fantasy), which in turn modulate social factors (relationships and sexuality). Understanding the balance of the biopsychosocial model can, therefore, inform effective treatment of transgender individuals, and those with gender dysphoria.

Pretreatment sexuality in trans persons

Body image and body dysphoria

A negative body image and low body satisfaction is more prevalent in transgender individuals who apply for gender-affirming treatment than in cisgender persons, as body dysphoria is one of the core elements of gender dysphoria[97].

Qualitative studies describe difficulties among individuals with gender dysphoria to be nude alone or with a partner and difficulties of touching one's own body or letting somebody else touch it, with a greater focus on satisfying a partner[43,44,98]. Body satisfaction is dependent on the degree of body and genital dysphoria, but also on coping strategies to handle the dysphoria[99]. Thus, some individuals use coping strategies such as imagining a different body, reinterpreting gendered body parts, or applying a gender role during sex congruent with their gender identity[42]. Studies have shown that gender-affirming treatment by itself increases body satisfaction[40,42,97,100–102]. However, paradoxically, accepting a need for gender-affirming treatment, disclosing a transgender identity to others, or beginning a medical and surgical gender-affirming treatment, can transiently increase body dysphoria and body dissatisfaction[40,43]. This phenomenon might exist because denial or neglect of the dysphoria is a coping strategy that is no longer possible when the person starts coming out for themselves and others, and when they begin to be asked questions about feelings of body incongruence by a health-care professional[103].

Sex, relationships, and orientation

Sexual experience, function, and satisfaction before gender-affirming treatment are likely to also influence sexuality and satisfaction after treatment. A vast majority (80–92%) of persons applying for gender-affirming treatment or those who had unmet gender-affirming treatment needs have, in the past, been sexually active with a partner[40,104]. However, only half of this group engaged their genitals in sexual activity, and only 12% of transgender women and 15% of transgender men in this group derived pleasure from involving their genitals in sexual activity[104]. Masturbation was reported by 72–78% of transgender women and 59–89% of transgender men[40,104]. Furthermore, in one study, 40% of transgender individuals with unmet gender-affirming health needs reported sexual dissatisfaction, even though sexuality was reported as important by 47% of the transgender women and 57% of the transgender men[40]. Previous traumatic sexual experiences with partners, friends, or unknown persons in childhood or adulthood are more prevalent in transgender persons than in the cisgender population[44,105–107]. Historically, some studies have suggested that childhood sexual abuse experience might be implicated in the aetiology of gender incongruence[108,109], whereas more recent papers have argued that minority groups are more vulnerable to sexual abuse[110–112]. Traumatic sexual and other experiences are certainly associated with increased psychiatric morbidity and render the person more vulnerable[113,114]. Sexual orientation is multidimensional, comprising sexual identity (self-labelling as gay, straight, bi, or other), sexual behaviour (whom you have sex with), and sexual attraction (to whom you feel attracted or fantasize about)[115]. The different dimensions are not always congruent; that is, some cisgender men have sex with cisgender men but are at the same time in a relationship with a cisgender woman and identify as straight[115].

Gender dysphoria is not related to sexual orientation and transgender individuals express the whole spectrum of sexual orientations — androphilic (sexual orientation towards men or masculinity), gynephilic, bisexual (sexual orientation towards both men and women), pansexual (sexual orientation towards individuals irrespective of sex or gender), asexual (sexual orientation towards no one and /or low sexual motivation and desire)[116], or queer[6,19]. Furthermore, sexual orientation in transgender persons can be fluid and dynamic, and can change during transition[19,104,117,118].

A multitude of factors, including access to a partner or partners, apart from or together with preferences, are important determinants in sexual satisfaction and might not be congruent with sexual behaviour. For example, a transgender woman attracted to men might be in a relationship with a cisgender androphilic man, which can influence her level of sexual satisfaction[44,104,119]. Transgender men and women can be in a relationship in line with their sexual orientation or not; transgender women are more often in a relationship not in line with their sexual orientation than transgender men[119]. Irrespective of gender, sexual relationships not in line with a person's sexual orientation involved less sexual activity using the genitals[119].

Many transgender persons find it difficult to establish a new relationship — whether sexual or not — both before and after gender-affirming treatment, sometimes owing to difficulties in finding a partner who respects them and views them according to their gender identity without objectification[44,104,119]. One study reported that 53% of transgender men and 37% of transgender women who sought treatment answered positively when asked if they had a current partner[119], but it must be borne in mind that having a partner might delay the coming-out process for those who fear losing their partner[120].

Sexuality and gender-affirming treatment

Effects of hormonal therapy

The goal of endocrine feminizing treatment in transgender women is to increase oestrogen to the levels observed in premenopausal mid-cycle cisgender females (400–800 pmol/l) and to suppress androgen-dependent pathways in order to induce the desired physical and mental changes. This effect is achieved with oral, transdermal, or intramuscular administration of oestrogen[80]. Oestrogen suppresses gonadotropin secretion and, therefore, testosterone production and secretion from the testis. In order to further suppress testosterone, gonadotropin-releasing hormone (GnRH) analogues or gestagens, such as cyproterone acetate or medroxyprogesterone, are often added[80]. Gestagens exert dual effects, suppressing testosterone production and blocking the androgen receptor (AR)[121]. The result of testosterone suppression is a change in body composition with increased fat mass, decreased muscle mass, initiation of breast development, softened skin texture, and reduced body hair[80]. Spontaneous and nocturnal erections usually disappear, semen production and spermatogenesis ceases, and ejaculate volume decreases, suppressing fertility[80].

Conversely, the goal of endocrine masculinization treatment in transgender men is to stimulate androgen-dependent pathways by increasing testosterone and suppressing oestrogen levels to the normal range for healthy cisgender males (50–180 pmol/l) and thereby induce the desired physical and mental changes[80]. Testosterone is administered transdermally (50–100 mg daily) or by intramuscular or subcutaneous injections (~100 mg per week), suppressing gonadotropin secretion and, therefore, oestrogen production from the ovaries and inducing physical changes including increased muscle mass, decreased fat mass, increased facial and body hair growth, increased risk of male-pattern hair loss, growth of the clitoris, and a deepening voice[80]. Furthermore, testosterone treatment usually induces a reduction in vaginal lubrication and cessation of menses, owing to the suppression of gonadotropins[80]. If cessation of menstrual periods does not occur, gestagens or GnRH analogues can be added[80]. Fertility is also suppressed while on treatment.

In general, androgen treatment in transgender men results in increased sexual desire and, eventually, improved sexual satisfaction. Endocrine treatment of transgender women reduces sexual desire and — depending on the patient's wishes to either maintain desire and/or erectile function or to experience lower desire and/or fewer erections — satisfaction with treatment varies[80]. After endocrine therapy, when nocturnal and spontaneous erections decrease in frequency and intensity, erections arising as a result of sexual stimulation seem more persistent[122].

For young people who have not yet gone through puberty, GnRH analogues can be used to arrest pubertal development, with the goal of suppressing development of unwanted bodily features and gain time for investigation and consideration of further intervention[123].

Endocrine therapy can also have effects on pain, and changes in pain perception due to endocrine treatment in transgender patients are of potential importance, but are not well studied. In the general population, the prevalence of chronic pain is higher among women than men[124] and several experimental animal studies have suggested that testosterone administration increases the pain threshold[125–128] whereas oestrogen lowers it[128]. Accordingly, some human studies have found that endogenous and exogenous testosterone reduces pain[129,130]. In a retrospective report, ~25% (11 of 47) of transgender women developed chronic pain concomitantly with oestrogen and/or antiandrogen therapy, whereas 60% (6 of 10) of transgender men reported a significant improvement in chronic headache that had been present before the start of testosterone treatment[131]. Although in these studies the investigated pain was not specifically related to sexual activity, the findings should motivate further study to elucidate the roles of cross-sex hormones in sexual pain, whether in cisgender or transgender persons.

Effects of gender-affirming surgery

Some individuals experiencing gender dysphoria request GAS in order to align their physical gender with their gender identity and ease their dysphoria[132].

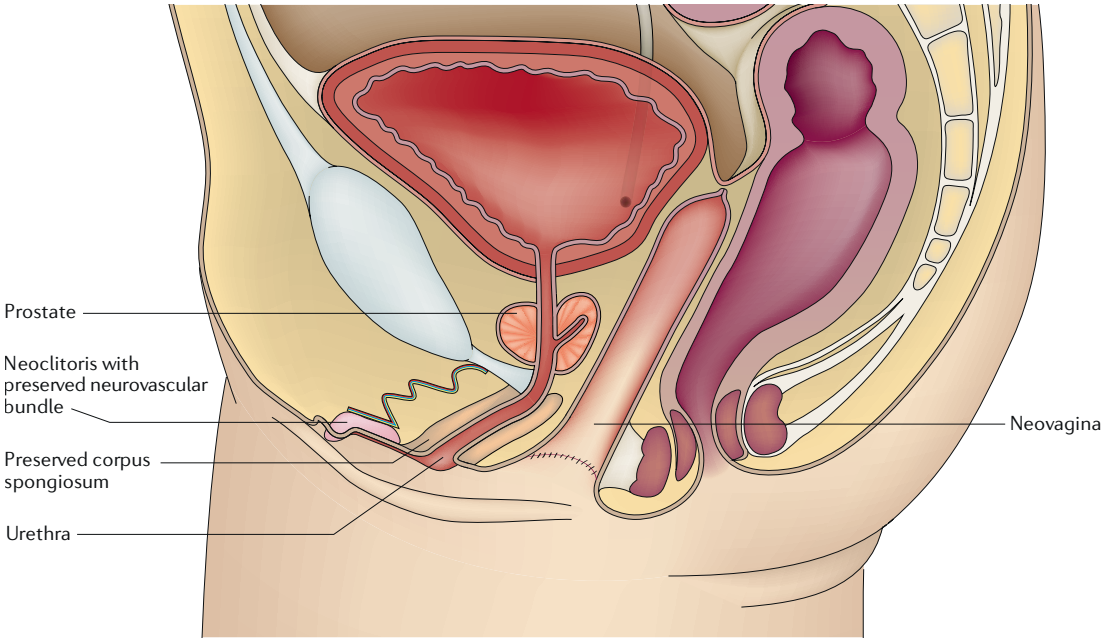

Fig. 2 | **Vaginoplasty.** A neovagina is formed in the space between the urethra and rectum. The corpus spongiosum is preserved and surrounds the urethra. A small piece of the glans penis is preserved, embedded, and formed to become the neoclitoris. From the dorsal side of the penile shaft the thin neurovascular bundle is preserved and buried below the neoclitoris to ensure vascularization and erotic sensitivity. The prostate shrinks with antiandrogen treatment. The space between urethra and neoclitoris can be covered with urothelium in order to enhance sensitivity.

Feminizing genital surgery for transgender women consists of removal of the penis and the gonads and creation of a vagina, labia, and clitoris (FIG. 2). Several vaginoplastic techniques are in use, the most common of which is the penile skin flap technique, whereby the skin of the penis, if sufficient, is inverted to form the vaginal wall. The anatomy of the male perineum and pelvis leaves a space between the prostate and rectum that enables formation of a neovagina. In order to maintain the new vagina and to ensure its persistence and suitable size for penetration, daily dilatation (vaginal dilators and/or vaginal sex) is usually needed, dependent on the surgical technique used[133]. Alternatives to penile skin for creation of a neovagina include scrotal skin, free skin grafts, or bowel segments[134]. The glans penis can be used for formation of a neoclitoris, with reasonably preserved genital sensitivity and sexual responsiveness[135–138]; the scrotum can be used to create the equivalent of labia majora. Feminizing surgery also often involves cricoid surgery, vocal cord surgery, breast augmentation, and facial feminizing surgery. Breast augmentation, in particular, has been shown to increase sexual well-being in transsexual women[102].

Masculinizing genital surgery in transgender men can include removal of the uterus and ovaries and optional vaginectomy, as well as creation of a neophallus. Two methods are generally used to create a new penis or a penis-like structure. For phalloplasty, a flap from the inguinal region, anterolateral thigh, or forearm is used to form the contours of a penis[139–144]. This type of neophallus lacks erectile properties, but erogenous sensitivity can be obtained through nerve anastomoses between flap nerves and the genitofemoral and clitoral nerves and via the clitoris, which is still present behind the neophallus[145] (FIG. 3).

Different donor sites are associated with corresponding differences in sensitivity and bulkiness. Several techniques are available for erection support, most of which involve a semirigid or inflatable prosthesis. An estimated 25% of transgender men who undergo phalloplasty receive a penile prosthesis[139]. All these techniques enable the possibility of engaging in penetrative sex, or, alternatively, a rigid condom or penile sleeve can be used.

A major achievement with phalloplasty is to enable voiding standing up. Among transgender men interested in phalloplasty, 62–99% stated that voiding standing up is a factor of high importance[146,147] and according to a meta-analysis, this was achieved in 73% of subjects[148]. In one study on genital confirming surgery in transgender men, 45% reported a strongly improved ability to void standing, although no effect on quality of life was reported[132]. Metoidoplasty is an alternative method used for creation of a penis in transgender men, which is facilitated by use of the testosterone-enlarged clitoris, whereby the visible part of the clitoris is further enlarged by luxation of the crura clitoris from its internal support. Compared with phalloplasty, metoidioplasty creates a smaller penis with maintained erectile properties and erotic sensitivity, although usually insufficient for full penetration due to inadequate length[149] (FIG. 4). Transgender men who have undergone metoidioplasty might subsequently request phalloplasty[150,151]. In both procedures, the labia majora are used to create a scrotum large enough to harbour testicular prostheses[134,139]. Nongenital masculinizing surgeries include liposuction

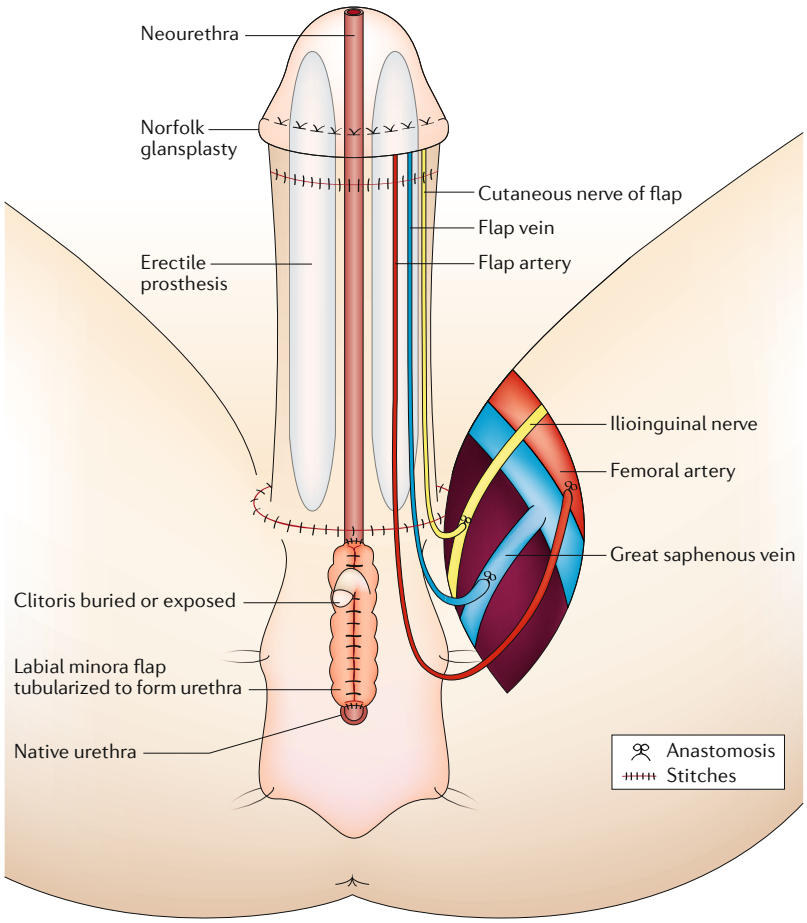

Fig. 3 | **Phalloplasty technique.** A flap from the inguinal region, anterolateral thigh, or radial forearm is formed to the neophallus. Vascularization and sensitivity is ensured by anastomosis with existing vessels and nerves. A sensitive clitoris is preserved and can be buried or exposed. For erection, a semirigid or inflatable prosthesis can be inserted in the neophallus, and scrotoplasty, including testicular prostheses, is also an option.

and mastectomy, and a few studies have evaluated effects of these techniques on sexuality. In a 2018 study of natal females aged 13–25 years with chest dysphoria, 50–60% of those who had not undergone mastectomy reported problems with dating, forming intimate relationships, physical intimacy, or sexual activity, compared with just 2–3% in the group who had undergone surgery[152]. One study has also reported a statistically significant positive effect of mastectomy on satisfaction of life in general and on feelings of self-worth[153], but no statistically significant improvement has been shown in pleasure of sexual activities, sufficiency as a sexual partner[153], or sexual quality of life[154].

Overall, the individual's sexual wishes and hopes are important parts of surgical decision-making[132], regardless of whether the patient is a transgender woman or a transgender man, or the type of surgery they seek.

Sexuality and access to care

Access to care and financing of medical care varies both within and between countries[2]. Eligibility criteria vary and contribute to differences in access to care. In some countries, the inclusion criteria for treatment exclude transgender persons who would be eligible for treatment in other countries. When treatment of gender identity became available in the mid-1960s, eligibility criteria were stringent and patients could be considered ineligible for treatment for a number of reasons that today are irrelevant, including high levels of sexual activity, homosexuality, and also being aroused by cross-dressing[16,21,22,155]. The gradual change from rather exclusive criteria to a more inclusive approach is still not fully integrated into clinical management. This lack of integration might hamper conversations about sexuality and sexual function between health-care providers and patients, as patients can fear being considered ineligible for gender-affirming care.

Post-treatment sexuality

Although the affirmation of gender by hormonal and/or surgical treatments could be considered the final step in managing the transgender patient, it does not necessarily provide a solution for sexual dysfunctions and, in fact, marks the beginning of a new life in which their sexuality and sexual health could require considerable support. On a purely biological and physiological level, hormonal therapy and surgery can have long-term effects on sexual function, while the reality of changing gender can have considerable psychological and social effects, which can also substantially affect sexuality and sexual function, according to the biopsychosocial model.

Desire

Sexual desire can be defined as the urge, drive, or lust that motivates us to engage in sexual activity, alone or together with someone else, and comprises sexual drive (biological), sexual motivation (cognitive) and responsiveness to stimuli[34]. The strength of this desire varies between individuals, particularly if a distressing dysfunction is present. A low level of desire might fulfil the criteria for a medical diagnosis such as hypoactive sexual desire disorder[156], whereas a high level of desire might fulfil a diagnosis of hypersexuality[157]. Gender differences in sexual desire are well recognized, with cisgender men generally reporting more intense and more frequent desire than cisgender women[158,159].

Sexual desire in transgender women. Gender-affirming treatment affects sexual desire in a majority of transgender women[160]. Retrospectively, 70% of the transgender women in one study self-reported a lower or much lower sexual desire ($P<0.001$) after gender-affirming treatment, compared with sexual desire before gender-affirming treatment[160].

Some transgender women report no change or even increased desire[160]. The effect of hormone treatment seems to be quite prompt, with ~60% of transgender women reporting low sexual desire 3 months after the initiation of hormonal treatment, compared with ~30% before hormonal treatment[161].

Low sexual desire should not necessarily be assumed to be a problem for the majority of transgender women, especially in the presence of strong genital aversion, and if vaginoplasty is not imminently available. In fact, it has been reported that only one in three transgender women

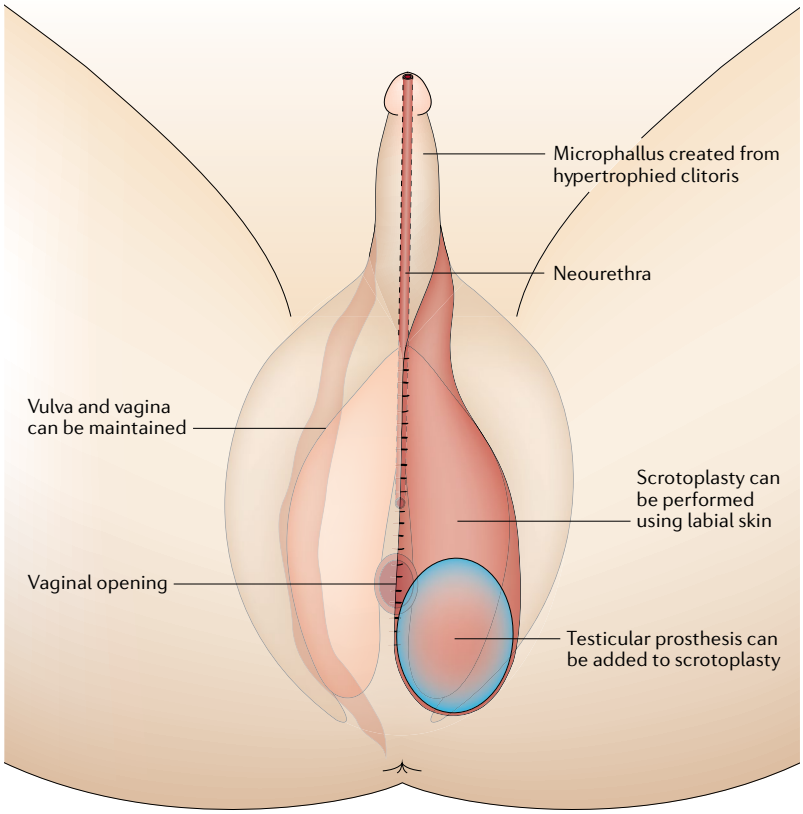
Microphallus created from hypertrophied clitoris
Neourethra
Vulva and vagina can be maintained
Scrotoplasty can be performed using labial skin
Vaginal opening
Testicular prosthesis can be added to scrotoplasty

Fig. 4 | **Metoidoplasty.** A microphallus with preserved sensitivity and erectile ability is created from the androgen-enlarged clitoris. Scrotoplasty, including testicular prostheses, is an option.

considered low sexual desire distressing[160]. A low sex drive can, therefore, be seen as a relief and can even be supported in clinical practice by provision of sex-drive suppressing medication.

The timing of the decrease in sexual desire after initiation of hormonal treatment together with the fact that testosterone levels are known to influence sexual desire in men[95] suggests that reduced desire would be precipitated by reduced testosterone levels caused by antiandrogen therapy. One study showed significantly lower levels of total and calculated free testosterone (cfT) in transgender women compared with a control group of ovulating cisgender women (T: 20.0 ± 9.6 ng/dl versus 33.9 ± 7.9 ng/dl, $P < 0.001$; cfT: 0.26 ± 0.16 ng/dl versus 0.47 ± 0.31 ng/dl, $P < 0.001$)[162]. Nevertheless, no studies have shown any significant correlation between levels of total or free testosterone and sexual desire in transgender women[160,162,163].

For some transgender women, low sexual desire can lead to personal or relational distress, fulfilling the diagnostic criteria for hypoactive sexual desire disorder (HSDD). Two studies have examined the prevalence of HSDD in transgender women compared with cisgender women using the Sexual Function Health Council's consensus definition[33]. Both reported that the prevalence of HSDD in transgender and cisgender women were similar, at 20% in transgender women compared with 27% in middle-aged women[164] and 26% in younger, surgically postmenopausal women[165] in one of the studies[160], and 33% in transgender women compared with 23% in a control group of ovulating women and 26% in middle-aged women[166] in the other study[160,162].

Whether surgical treatment for transgender women enhances or reduces sexual desire is not known. One study compared desire in transgender women after vaginoplasty with transgender women on the waiting list for surgery, and showed that those who had undergone surgery reported higher sexual desire than those who had not, suggesting that gender-affirming surgery might have a positive effect on sexual desire[160]. This effect is likely to be due to improved body satisfaction. Seven publications[163,167–172] have used the standardized female sexual function index (FSFI) questionnaire — which was developed and validated for penetrative sex in cisgender women — to evaluate desire in transgender women, including assessment of desire, arousal, lubrication, orgasm, satisfaction, and comfort[173,174]. In these studies, the transgender women's average score in the 'desire' subdomain was comparable to that of cisgender women without sexual problems[163,167–172].

When considering sexual desire in the transgender population, it should be borne in mind that few studies on transgender sexuality after gender-affirmative treatment have evaluated the prevalence of depression and the use of pharmacological treatment with sexual side-effects among the participants, despite the fact that 25% of the included transgender women in one study were treated for depression[175].

Sexual desire in transgender men. Just as in transgender women, gender-affirming hormone treatment affects sexual desire in most transgender men[118,176–178]. Several studies have examined changes in sexual desire after initiation of testosterone treatment but before gender-affirming genital surgery, and unanimously describe a trend towards increased sexual desire after testosterone therapy[118,176,177], which is also described as more urgent, less controllable[118], and more frequent[176]. As in transgender women, the effect of gender-affirming hormone therapy on sexual desire occurs soon after treatment, within 3 months of initiation of endocrine treatment[161]. However, even though a majority of transgender men report increased sexual desire, a small percentage of transgender men remain unaffected and, in one prospective study, ~10% reported reduced desire after gender-affirming hormone treatment[176]. In this specific study, other possible confounders causing low desire, such as disappointment with bodily changes due to the use of relatively low doses of testosterone, were not taken into consideration.

In transgender men, no association has been reported between total or free testosterone and sexual desire[176,177]. However, the level of luteinizing hormone (LH), which reflects testosterone levels, has been negatively associated both with solitary and dyadic sexual desire[177], indicating a connection between desire and the pituitary–gonadal axis. The relationship between LH and desire in transgender men is likely to resemble that of cisgender men, but there might also be differences, such as different embryonic and/or neonatal priming of the male and female brain.

One study has examined the prevalence of HSDD in transgender men and reported a rate of 5%, which is comparable to the general cismale population[160]. In the same study, a level of increased sexual desire that caused personal or relational distress was reported by 3.6% of the transgender men[160]. The prevalence of hypersexuality in cisgender men is estimated to be 2–6%[179–181], although a comparison with transgender men is not meaningful owing to the lack of information about compulsiveness in transgender men and of a generally accepted diagnostic definition of hypersexuality.

The combined effect of both testosterone treatment and genital surgery on desire has been investigated in 45 transgender men, 8 years after gender-affirming phalloplasty[177]. In this retrospective study — one of only a few studies that used a validated scale for measurement of sexual desire, The Sexual Desire Inventory (SDI) — 73% of trans men reported much higher or increased sexual desire after surgery, and 25% reported no difference. No specific information has been reported regarding effects of surgery alone on sexual desire, but one interesting finding is that postoperative desire in men who had undergone phalloplasty with an erection prosthesis did not differ from those without an erection prosthesis[177]. Furthermore, satisfaction with the surgery did not influence desire[177]. These data indicate that surgical outcome is not the only relevant predictor in sexual functioning after gender-affirming treatment. In another study, just 12% of trans men reported reduced desire following gender-affirming treatment with hormones (100% of participants) and surgery (85% of participants)[160], which is in stark contrast to the high numbers (>70%) of trans women who report reduced desire after treatment.

Sexual arousal

Sexual arousal refers to both the subjective feeling of arousal and the physiological response that occurs with sexual activity. This response includes increased heart rate and respiratory frequency, accompanied with increased blood flow to and swelling of the genitals resulting in penile erection or clitoral engorgement, and, in women, vaginal lubrication. In natal females, vaginal lubrication comes from Bartholin's glands and Skene's glands and from increased blood flow in the vagina, which results in exudation of fluid[182]. Lack of genital arousal and lubrication for both cis and trans women, and for transgender men who choose to retain their vagina, can cause discomfort or pain during vaginal sexual activity. The subjective experience of sexual arousal can be measured by validated questionnaires, and objective measurements can be taken using plethysmography[183], which assesses vaginal vasocongestion, or laser Doppler imaging[184], which measures vulvar blood flow, and functional MRI (fMRI)[185–187] for brain activity. Notably, subjective and objective arousal are not always concordant[188].

Not all transgender persons want, need, or can even afford to undergo gender-affirming genital surgery[2,15,118,189]. As a consequence, the genital effect of hormonal therapy in each individual depends on which genital organ is, or is still, present.

Sexual arousal in transgender women. For transgender women with a penis, the physical sexual arousal phase includes the ability to achieve and maintain penile erection. Erectile ability is, to some extent, dependent on intermittent increases in penile blood flow with increased oxygenization, which usually occur as nocturnal tumescence and erectile episodes, which are testosterone dependent[87]. One study has examined the effect of androgen depletion on erection in transgender women who retain their penis, and found no difference in patient-reported outcomes before and after cross-sex hormone treatment, although the frequency of nocturnal erections, measured with a Rigiscan on two consecutive nights, were reduced in almost half of the transgender women. The result of the nocturnal penile tumescence test also correlated ($P = 0.006$) with serum testosterone levels. These data support the existence of androgen-dependent nocturnal erections in transgender women who retain their penis[122]. Studies in cisgender men have shown that reduction in nocturnal erections is a risk factor for development of penile fibrosis and erectile dysfunction[190]. For transgender women who wish to maintain erectile ability, occurrence of nocturnal and spontaneous erections might, therefore, be important, and can be supported by low-dose testosterone and/or the use of phosphodiesterase type 5 (PDE5) inhibitors[191].

Experimental studies have examined sexual arousal in transgender women with a neovagina using vaginal photoplethysmography to measure vaginal blood flow[192–194] or fMRI to examine cerebral activity[185,186] at baseline and while watching an erotic video[185,186,192,194]. The results of these studies demonstrate several similarities between transgender and cisgender women. Baseline waveforms of vaginal pulse amplitude (VPA) in trans women were comparable to that of cisgender women[193], and transgender women's subjective arousal correlated with their vaginal arousal as well as, or better than, that of women in a cisgender comparison group[194]. Brain activation patterns associated with visual sexual stimulation in transgender women were similar to those observed in premenopausal cisgender women[186]. However, differences were noted in vaginal photoplethysmography response during neutral stimuli in trans women, with a stimuli response that was substantially smaller than that of the cisgender women[194]. This discrepancy is most likely due to anatomical differences, such as the higher vascularization and innervation of the cis vagina than the neovagina[194].

Subjective arousal in transgender women has been investigated in a series of studies and all report that a majority of trans women were able to experience aro usal[163,167–170,175,192]. The average FSFI subdomain score for arousal in transgender women mostly resembles that of cisgender women with sexual problems[163,167–172] such as low desire or pain[173]. Somewhat contrary to the reported decrease in sexual desire, one study has also found an increase in subjective arousability following gender-affirming treatment[175].

One study has reported that the ability to experience arousal after gender-affirming surgery might require a lag time of up to 6 months[168]. Although physical recovery from surgery is a factor, this lag might also be due

to additional factors, such as adapting to the changed body and paused sexual activity while this adaptation takes place[44].

Several studies have reported that neovaginal lubrication is not only possible but that the majority of transgender women experience vaginal lubrication after surgery[135,138,175]. However, despite the fact that many transgender women report lubrication during arousal, the skin that is commonly used to line the neovagina provides less moisture than a natal vagina, making use of lubricants a necessity during penetration and dilatation training[195]. Lack of lubrication is less frequent with use of the intestinal vaginoplastic technique than with the use of a skin flap technique[133,171], but might be complicated by side effects such as mucorrhoea[196,197] or stenosis at the anastomotic site[133]. Nevertheless, lack of arousal, lubrication, and pain are often reported as major concerns after surgery[138,163,167–170,198]. If only sexually active transgender women are included in the analysis, the reported levels of arousal and lubrication are more in line with cisgender women without sexual problems[167,168]. However, many trans women are not sexually active; celibacy in this population might be due to lack of arousal, lubrication, pain, or a lack of desire, or other unknown reasons, but no studies have been carried out to investigate this situation.

Sexual arousal in transgender men. Transgender men, just like transgender women, do not always undergo GAS[2,15,189,199]. In a long-term study from Amsterdam including 1,401 patients, 39% of transgender men underwent phalloplasty and 76% of transgender women underwent vaginoplasty. Thus — as in transgender women — the transgender men's sexual situation will differ according to the genital organs present. Sexual arousal in transgender men has received little attention beyond the subjective experience of feeling aroused. In transgender men with a vagina, physical sexual arousal in the genital sense of the word mainly is influenced by a thinning of the vaginal epithelium caused by androgen treatment[200]. This vaginal atrophy is known to cause vaginal dryness and dyspareunia in naturally[201] and surgically postmenopausal[202] cisgender women.

Self-reported sexual arousability has been examined prospectively before and after 1 year of hormonal therapy[176]. This study reported significantly increased frequency of desire ($P = 0.0014$), masturbation ($P = 0.0001$), sexual fantasies ($P < 0.0005$), and arousal ($P < 0.0005$) after 1 year of testosterone administration[176]. These data are also supported by a retrospective study reporting a significant increase in frequency of masturbation ($P = 0.023$) after hormonal treatment[175].

No objective method is able to measure penile sexual arousal in phalloplasty patients in whom erection is accomplished with a bone graft or a prosthesis as, in these patients, erection is not arousal dependent. Regarding arousability, the natal clitoris is modified and left in place behind the neophallus, usually with preserved sensitivity[145]. One of the clitoral nerves is sometimes used to enable development of sensitivity in the neophallus[136,203]. Between 50–100% of men who have undergone GAS have reported experiencing erogenous sensation in the neophallus[203–205], with the exception of one study that reported obvious erogenous sensation in only 9% on tactile stimulation, although 83% had functioning sensory sensitivity[206]. This seemingly contradictory report could possibly be explained by differences in questionnaires being used.

Metoidioplasty produces a smaller penis than phalloplasty but, in the majority of patients, it is capable of a physiological erectile response[149,207,208]. However, anatomical differences in the penile and clitoral size and structure mean that it is seldom possible for this erection to be used in penetrative sex[149,207], although one study claimed intromission was possible for 70% of patients in their metoidoplasty cohort[208].

Orgasm

Orgasm, or climax, denotes the highest point of sexual excitement, characterized by feelings of pleasure and accompanied by pelvic contractions and ejaculation or increased vaginal lubrication. Orgasm can be achieved through penile or clitoral stimulation as well as through stimulation of other erogenous zones including the prostate, anus, breasts, or nipples. Difficulty in reaching orgasm is commonly reported in cisgender persons, with 16% of women and 9% of men reporting anorgasmia in a British national survey[159]. Orgasm can be subjectively assessed using questionnaires such as the Brief Index of Sexual Functioning for Women (BISF-W)[209] or the FSFI[174], and can be objectively measured using fMRI[210], or — less commonly — positron emission tomography[211] or rectal pressure[212].

Orgasm in transgender women. The question whether transgender women are able to achieve an orgasm after vaginoplasty has been addressed in several studies. In the majority of these studies, 62–100% of transgender women with a neovagina reported orgasmic ability[133,136,171,175,193,213–227]. A few studies described cohorts with a lower prevalence of orgasmic ability (27–48%)[192,228–231], but many of these studies are small and are limited by selection bias, have not used validated questionnaires, include both sexually active and inactive transgender women, and are mostly retrospective and lack control groups. Overall, one can conclude from these studies that orgasm in postoperative transgender women is a possibility. As is the case in cisgender women, it seems to be easier for transgender women to reach orgasm during masturbation than in connection with partner-related sex[175].

Data suggest that a majority of transgender women experience a change in quality of the orgasmic feeling after surgery[175,215–217,219,220,227]. The 'new' orgasmic feeling has been described as more intense[175,219], smoother and longer[175], more pleasing[220] and more pleasurable[227] than the quality of their preoperative orgasms. However, vaginoplasty can also result in loss of orgasmic ability or experiencing less orgasmic sensation[167].

Several studies have also confirmed orgasm-triggered secretions in transgender women[135,175,193,220,227,232] — that is, the ability to ejaculate. The anatomical correlate to this is not clear but, in analogy with lubrication, it might involve the retained Cowper's glands[233] or the remaining prostate and seminal vesicles[234].

In transgender women who retain their penis, inadequate erection and ejaculatory difficulties as a consequence of low testosterone levels might be a concern[59].

Orgasm in transgender men. Transgender men's ability to orgasm is less well studied and has focused on *trans* men who have undergone phalloplasty or metoidioplasty. The effect of hysterectomy has not been studied in postoperative transgender men. Hysterectomy is not known to affect orgasm capacity in cisgender women[235].

In general, orgasm is reported to be possible for many transgender men regardless of whether they have undergone phalloplasty or metoidioplasty, although prevalence estimates vary from 25% to 100%[136,149,175,205,223,231,236,237]. Just as in transgender women, orgasm through masturbation seems to be more prevalent than through sexual intercourse[175,223].

No studies have specifically addressed orgasm in transgender men with a vagina. However medical interventions are unlikely to have a negative effect beyond the vaginal dryness that usually occurs as a result of oestrogen deficiency. Hypersensitivity of the enlarged clitoris can be an issue[137], but whether this affects orgasmic ability is unclear.

A change in orgasmic experience after endocrine and surgical treatment has been reported in most transgender men[175,223,237], and has been described as the orgasm being more powerful and shorter[175] or being more intense[237]. No difference in orgasmic feeling has been described between those patients who have undergone phalloplasty with or without a penile prosthesis[237].

Pain during sexual activity

Pain during sexual activity can be caused by a multitude of factors including insufficient arousal, surgical complications, or muscle tension[139,238,239]. Transgender men and women might be afraid of damaging their new organs, or have painful experiences from dilatation of the neovagina during the immediate postoperative rehabilitation, potentially leading to muscle tension and consequent pain[240]. In cisgender populations, pain during sexual activity is reported to occur in 1.8% of men and 7.5% of women[159,241] and, correspondingly, pain and lack of arousal and lubrication are reported as major concerns after surgery in transgender women, but prevalence data regarding these factors are unreliable[163,175,198,242]. These problems are associated with lower sexual satisfaction in both cisgender[238] and transgender populations[138]. The average FSFI subdomain for pain in transgender women is similar to that of cisgender women with sexual problems[173] such as low desire or pain[163,167–170,172], although a 2018 study of trans women who underwent pedicle transverse colon flap reported numbers that are more in line with cisgender women without sexual problems[171]. Complications after phalloplasty or metoidioplasty are generally more common than after vaginoplasty[139,150,243,244]. The report of pain during intercourse in >50% of men with an erection prosthesis is particularly concerning[175,237]. Pain during sexual activity in transgender patients that is not related to phalloplasty or metoidioplasty has not been studied.

Sex, relationships, and sexual orientation

Sexual activity, whether masturbation or partner sex, is generally reported to increase or remain unchanged in transgender men after gender-affirming treatment[160,175,176,245,246], but in one study, 11% of transgender men reported no masturbation after gender-affirming treatment[160]. For transgender women, some studies report increased or unchanged sexual activity[175,227,247,248] and others a decrease[245,246]. In cross-sectional studies, sexual activity with a partner or masturbation after GAS is reported in 50–89% of transgender women[40,198,227]; thus, 11–50% of trans women are sexually inactive after gender-affirming treatment. The numbers are similar for transgender persons who have unmet needs for GAS. Most studies are cross-sectional or retrospective, and few prospective studies have described the effect of GAS per se on sexual activity. One prospective study with a small sample of transgender women found that those who were sexually active before GAS remained so after treatment, and vice versa for the sexually inactive[228]. Most studies report that around 35–40% of transgender women and 40–75% of transgender men are in a relationship with a partner after transition[160,249–251] and the number of transgender men who reported being in a relationship did not change after treatment[176]. Satisfaction with partner relationships improves for both genders after gender-affirming treatment[175,249]. Initiating a new relationship can be difficult for trans persons both before and after gender-affirming treatment, and many trans persons report difficulty in finding a partner who is able respect them and see them according to their gender identity, who does not objectify them, and who can accept their level of sexual self-esteem and their sexual agency[44,104,119,176]. Research suggests that it can be more difficult for transgender men to initiate a relationship than for transgender women[175], but the reasons for this situation are unknown. One could speculate that it is due to differences between transgender men and transgender women and cisgender men and cisgender women: for example, transgender men are generally younger than transgender women at the time of initiating treatment, transgender men are more gynephilic than transgender women are androphilic, and their eventual sexual partners — whether cis or trans — might differ in their own preferences.

Sexual orientation in transgender persons can be fluid and can change during social and medical transition[19,104,117,227,252]. One study has shown that transgender individuals with a sexual orientation towards their assigned sex at birth were more likely to change sexual orientation after transition[117], and reported that, during social and medical transition, transgender men became more androphilic[252].

Sexual satisfaction

Sexual satisfaction is a subjective experience elicited from evaluation of positive and negative feelings associated with one's sexuality and is dependent on an individual's expectations[253]. Sexual satisfaction does not necessarily depend on the level of satisfaction with surgical outcome, as a patient could be discontent with the surgery and still content with sexual life[249] or vice

versa[214]. In the cisgender population, sexual dissatisfaction is common, with ~10–50% of sexually active participants and 20–30% of sexually inactive participants reporting dissatisfaction[159,254].

Sexual satisfaction in transgender women. Between 50% and 100% of transgender women report sexual satisfaction after gender-affirming treatment[193,198,213–216,219,222,225,229,232,236,255]. Studies suggest that sexual satisfaction is similar[256] or worse[162] in transgender women than in cisgender female control participants. Furthermore, gender-affirming treatment improves sexual satisfaction compared with baseline preoperative levels[42,135,175,198,247–249]. Some studies have reported decreased sexual satisfaction after treatment in 5–12.3% of transgender women, possibly related to pain, lack of sensation, or difficulties in relaxing[175,249]. Factors associated with improved or good sexual satisfaction include hormonal treatment[154,257], vaginal function and depth, clitoral sensation, appearance of the vulva and labia minora, natural lubrication[135], satisfaction with vaginoplasty[175], satisfaction with the new genitals[175], being generally satisfied[175], and having a partner[154,175]. Factors associated with low sexual satisfaction include depression[135] and surgical complications such as vaginal stenosis, clitoral necrosis, and postoperative pain in the neovagina or genitals[138].

Sexual satisfaction in transgender men. Sexual satisfaction is reported in 34–100% of transgender men after treatment[118,149,175,214,237,251,258,259]. In studies comparing sexual satisfaction in transgender men with cisgender control participants, the picture is mixed: sexual satisfaction was worse in transgender men than in cisgender heterosexual men[256] but in line with cisgender gay and bisexual men[118]. Similar to transgender women, gender-affirming treatment improves sexual satisfaction in the majority of transgender men[149,175,249,251], but a minority of men report worse sexual satisfaction after treatment, possibly due to prosthesis pain or difficulties in finding a new partner[175]. Increased frequency of sexual activities and orgasm has been associated with better sexual satisfaction in transgender men[259]. One study has also reported a significantly higher sexual satisfaction in transgender men who have undergone metoidioplasty than after phalloplasty[132].

Supporting sexuality in transgender persons

In many aspects transgender persons are just the same as cisgender persons. Sometimes these common aspects are forgotten and assessment and treatment become too transgender specific. To support sexuality in transgender persons, clinicians must apply the same knowledge we have regarding supporting sexuality in cisgender persons and add transgender-medicine-specific knowledge[260].

Sexual history

Sexual dysfunctions are common in both cisgender[261] and transgender persons[37,40,44], a considerable number of whom remain undiagnosed and untreated[261]. Improved training in communication skills related to sexuality, and increased familiarity with dealing with sexual issues can promote improved care of patients who present with sexual issues[53,261,262]. Sexual history taking is a skill[53,261–263], and many clinicians report that sexual history taking is limited by time constraints, fear of offending the patient, discomfort about asking patients sexual questions irrespective of gender, deficits in communications skills, and inadequate training[261,262].

Sexual history and assessment in transgender persons follows the same principles as for history taking in cisgender persons, with the addition of transgender-specific questions. One also needs to be aware of transgender health and to use inclusive language. Sexual history should be part of the medical history and could follow questions about any other aspect of health. Beginning the sexual history with open questions is often helpful, for example, "Are you satisfied with your sexual life?" or "Are there any sexual problems or concerns you would like to discuss?" Relating questions to other patients can also be helpful; for example, "People who have the symptoms you describe or are on this medication also commonly have sexual problems. Is that something you would like to discuss or need help with?"[261,264]. If the patient would like to discuss sexual concerns, follow-up questions should explore the different phases of the sexual response cycle, sexual motivation, sexual desire, arousal, orgasm pain, general sexual satisfaction, and the importance of sexuality for this patient[261,264]. A further assessment should be performed with reference to the biopsychosocial model.

Language can be used to discriminate and marginalize transgender persons and use of transgender-inclusive, non-normative language will facilitate communication regarding transgender general health and sexual health[2,14]. Examples of transgender-inclusive language and questions include consideration of how someone identifies and what pronoun they use, and whether they have a partner or partners (not wife or husband). Sexual orientation is self-defined and transgender persons define their sexual orientation in accordance with their gender identity and not sex assigned at birth[2,14]. Furthermore, sexual history often includes naming of the body parts or body functions related to body dysphoria, which has been shown to actually increase body dysphoria[265]. Thus, use of gender-neutral words, such as "arousal" instead of "erection", and even to ask "What do you call this body part, which in medical language is called the clitoris in cisgender women?"[265].

Many questionnaires and scales are used to assess sexual dysfunction[53,261], but most of them are bigender normative, heteronormative, or require that the patient have a partner[266]. Thus, if questionnaires are used, they should be checked and — if necessary — modified to better meet the needs of transgender patients and not ostracize them[266].

Biological assessment

From a biological perspective, reviewing general health status and, specifically, endocrine status is an important aspect of patient care. Lack of sexual desire in any patient can be caused by hypothyroidism[95,267] or in transgender women by antiandrogen-induced hyperprolactinaemia[268]. Oestrogen and testosterone supplementation in

the transgender patient should be evaluated in order to verify that in-treatment hormone levels are within the target range, which equates to the reference range in healthy cisgender subjects[80]. After surgery, an examination to assess complications that might affect sexual function, such as scar tissue inflammation, rupture of the suture line or additional opening of the posterior commissure in transgender women[269], or urinary fistulae in transgender men[270]. Furthermore, signs of depression as a cause of low sexual desire and/or low self-esteem should be assessed both before and after gender-affirming treatment and treated according to local clinical guidelines. The use of medications with known sexual side effects — such as finasteride, SSRIs, prolactin-raising psychopharmacological agents, and opioids — should be avoided if possible.

The psychosocial sexual assessment

Evaluation of the importance of sexuality to a patient, their sexual satisfaction, and sexual functions, is important to determine how bothersome sexual issues are to a particular person. A psychosocial history, including present and previous mental health problems, should be taken[263]. Important questions include whether the person has been or is in a relationship at present, whether a relationship is important, whether any problems exist in an ongoing relationship, or if they have had difficulties with finding a partner. Furthermore, the clinician should assess whether any relationship difficulties are related to the person's transgender identity, or identified as someone who has transitioned. If the person is gender identified by others according to their gender identity, they should be asked how they feel about telling others about their background. Asking whether the person is comfortable enough to touch, or let others touch, their body, is important and relevant. The clinician should assess the level of residual gender dysphoria that remains, despite ongoing or performed gender-affirming treatment. One could also assess sexual agency and sexual self-esteem. Finally, they should query whether the person is able to live the sexual life that they want, or whether they put up boundaries for themselves, and if they feel safe during sexual encounters or engage in risky sexual behaviour[40,43,271].

Medical treatment of sexual disorders

Testosterone treatment was evaluated in seven transgender women with HSDD with a dose that produces testosterone levels similar to those in cisgender women (300 μg/day) for 24 weeks[272]. Testosterone therapy resulted in a significant improvement in sexual desire (from 2.57 ± 0.53 before treatment to 3.29 ± 0.95 afterwards; $P = 0.025$), as well as in all other domains included in the Brief Profile of Female Sexual Function questionnaire. No unwanted or adverse effects were reported during the study and all but one woman decided to continue treatment after the study was terminated[272]. These data suggest that testosterone therapy could be a treatment option for transgender women suffering from low desire.

Some studies indicate that insufficient hormonal treatment producing subnormal steroid hormone levels (compared with the cisgender reference range) is not uncommon in transgender patients[176,177]. Low levels of serum sex steroids are likely to affect sexual desire[80]. General guidelines concerning choice of hormonal treatment and achieved hormonal levels[80] should be followed, although attention must be paid to the substantial differences observed in individual patients' response and responsiveness. Monitoring hormonal levels once or twice per year (and more often at the beginning of treatment) is essential for assessment of hormone levels and assists in interpretation of clinical responses. Variability exists in uptake, distribution, and elimination of administered oestrogen and testosterone, resulting in considerable interindividual and intraindividual variation. Thus, monitoring must be standardized regarding blood sampling in relation to time of hormone administration, time of day, and fasting or nonfasting conditions. Analytical methods must be accredited and the laboratory involved in a quality-controlled programme ensuring appropriate quality, reproducibility, and sensitivity, and must cover the expected concentration range. Assessment of haemoglobin response and LH suppression are examples of pharmacodynamic end points when assessing androgen treatment. In addition, prolactin levels should be monitored in both transgender men and women. Prolactin is known to mitigate sexual drive and — in cisgender men— erectile function[95]. Prolactin levels can be increased by oestrogen treatment, various central nervous system-targeting drugs (such as antidepressants and anxiolytics) and also gestagens, especially cyproterone acetate[273]. Thus, monitoring of prolactin can be a useful tool to understand potential confounding mechanisms in maintaining acceptable sexual function in trans patients.

PDE5 inhibitors (PDE5i) can be useful in transgender patients. PDE5i cause vasodilatation and increased blood flow, especially in the genitals, via a partly testosterone-dependent mechanism[274]. In the case of erectile dysfunction in transgender women who retain their penis, PDE5i therapy is likely to improve the ability to achieve an erection just as in hypogonadal cisgender men[275]. Intracavernous alprostadil in transgender women has been reported to produce a normal erectile response[122]. Transgender men with a vagina can suffer from dryness due to oestrogen deficit in the vaginal lining, which can be treated with local oestrogen, as in cisgender postmenopausal women[276]. Transgender women with a neovagina sometimes produce vaginal lubrication; if not, lubricants or local oestrogen can be used[277]. Depression and anxiety disorder often hamper sexual function in transgender men and women and are, therefore, important to diagnose and treat. Depression and anxiety disorder can be treated with psychotherapy; if pharmacological treatment is used it is important to avoid drugs with negative sexual side effects.

The role of physical therapy

Physical therapy can be used to reduce pain and tense pelvic muscles in cisgender persons[278,279]. To our knowledge, no studies have specifically investigated the role of physical therapy in transgender individuals, but it is

likely to be helpful for genital pain in transgender people and in cases of narrow neovagina. Furthermore, body awareness therapy can improve sexual health in cisgender women[280] and might, therefore, be useful for transgender persons.

Psychotherapy and psychoeducation

Psychotherapy to address self-esteem, internalized transphobia or transnegativity, depression, and anxiety can be beneficial in trans men and women, and couples therapy can be recommended if relationship issues hamper sexuality[281].

Sexual dysfunctions can be treated with cognitive behavioural therapy, mindfulness-based cognitive therapy and sex therapy, and sensate focus therapy[45,46,282–284]. In transgender women, beneficial effects of sensate focus therapy have been reported but hitherto not published in the peer-reviewed literature[285]. Studies exploring the effect of different psychotherapy techniques to improve sexuality in transgender persons are needed.

In many countries, sex education is part of the school curriculum for teenagers. However, this sex education can be difficult to interpret for transgender teenagers, as it is often cisgender normative. Furthermore, sex education can, in fact, increase gender dysphoria and anxiety. Thus, psychoeducation regarding sexual function in general, as well as social and sexual skills, should be a topic for discussion as part of the counselling offered before and during gender-affirming treatment.

Coping strategies for body dissatisfaction have been published in the literature and made available as self-help material from LGBT organizations[44,98,271]. A useful coping strategy is to conceptualize gendered body parts as acceptable: 'it works, why can't I use it; I enjoy it'; or renaming gender body parts: 'this is my penis', 'I have a frontal opening, not a vagina'. Having sexual encounters with a partner with whom the person feels safe and who respects those parts of the body that are not supposed to be touched can also act as a coping strategy. Dissociation from the body or parts of it, use of sexual fantasies, pleasing others, and not being naked during sexual activity are other possible coping strategies for trans persons to maximize their sexuality and sexual function[44,98,271]. Furthermore, peer-group support is valuable for transgender health in general and is also likely to be valuable for sexual health[286,287].

Conclusions

In general, evidence suggests that medical treatment improves most dimensions of sexual function in transgender men and women who have undergone gender-affirming treatment. Whether this improvement results in a satisfying sexual life is less certain. Research into this topic is subject to numerous methodological disparities and, therefore, results should be interpreted with caution.

Many studies in transgender persons show better results in sexual variables than among cisgender persons, indicating that there might be a tendency to overestimate results, probably due to selection biases. In addition, many transgender persons report that they do not engage in sex at all after gender-affirming treatment[167–170,177,214,237,251]. Historically, transgender persons have been viewed as being hyposexual[21,22,155]. However, this situation is not the case and it raises the question of whether low sexual activity might be a result of insufficient care or the transgender experience itself — all humans need to develop a healthy relationship with their own body during childhood, a process that can be severely hampered by the presence of gender dysphoria. This possibility warrants further investigation.

Most transgender persons request hormone therapy, and it seems that the change in sexuality induced by endocrine therapy is welcomed. The main exception to this positive response to hormone therapy is low sexual desire experienced by some transgender women. However, knowledge is lacking regarding the choice of treatment, the dosing, and the therapeutic goals of endocrine treatment, all of which might result in treatment modalities negatively affecting sexuality.

Surgical intervention is more complex, with transgender persons desiring a variety of interventions from no surgery at all, top-only or bottom-only procedures, to a multitude of operations, making evaluation even more difficult. Among nonoperated transgender women, low sexual desire and erection problems are most common and in those transgender men who have only undergone mastectomy, vaginal dryness is a common clinical problem. The satisfaction with genital surgery is generally high[175], although many patients report pain, arousal, and/or lubrication difficulties after vaginoplasty[163]. Phalloplasty is generally considered satisfactory[132,175,205,237] by patients who have received appropriate advice and counselling[132,288] and have chosen the technique in accordance with their wishes[146]. Satisfaction levels are high in transgender men, despite the fact that erections are not possible without a prosthesis. Pain and other complications are problematic in those with a prosthesis[244]. Metoidioplasty enables a physiological erectile response to sexual stimulation, although it can rarely be used for penetrative sex[150].

In addition to medical aspects of gender-affirming treatment, costs and availability of health care[118], as well as attitudes among health-care providers[29,44,289], can certainly influence transgender persons access to sexual health services.

Regarding research, numbers and quality of studies on transgender persons' sexuality is increasing and several studies have also focused on transgender persons own narratives[43,44,290], which add perspectives that are otherwise difficult to capture. However, methodological improvements are needed, such as the use of appropriate control groups, validated scales, increased sample sizes, and prospective designs. Instruments for assessment should be validated in the transgender population. Furthermore, transgender persons should be asked for their opinions regarding which questions are of importance and on the study design in order to better understand and improve sexual health in individuals with gender dysphoria before and after gender-affirming treatment.

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